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LINGARD

ON THE

DECAY IN TIMBER.

LONDON:

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1827.

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James Whiting, Engraver and Printer to his Majesty, Beaufort House, Strand.

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S. H. 1827

A

PHILOSOPHIC AND PRACTICAL
INQUIRY

INTO

THE NATURE AND CONSTITUTION

OF

TIMBER;

BODLEIANA BIBLIOTHECA

INCLUDING AN

INVESTIGATION INTO THE CAUSES OF DRY ROT,

AND A PROPOSAL FOR EFFECTUALLY

PRESERVING TIMBER AGAINST PREMATURE DECAY.

DEDICATED TO THE
PRESIDENT AND MEMBERS OF THE HORTICULTURAL SOCIETY.

By JOHN LINGARD, Esq.

"J'ai bonne cause."

"By just induction from experiments and observations, to discover the laws of Nature, and then to apply those laws to the solution of the phenomena in question."—Sir Isaac Newton.

SECOND EDITION.

LONDON:
PRINTED FOR THE AUTHOR:
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1827.

596.

James Whiting, Engraver and Printer to his Majesty for the Prevention of Forgery,
Beaufort House, Strand.

TO THE

PRESIDENT AND MEMBERS

OF THE

HORTICULTURAL SOCIETY.

MY LORDS AND GENTLEMEN,

In dedicating this little treatise to the President and Members of a Society of such universal interest, I hope I am not assuming more than the importance of the subject of it demands; and I trust also that the manner in which I have treated it will, upon perusal, justify the liberty I have taken, in thus publicly soliciting your patronage and countenance of an hypothesis which bids fair to simplify, by analogies, one of the most complicated questions that has ever arrested the attention of scientific men;—namely, the origin of fungi, and the cause of premature decay, called DRY ROT, in Timber. My opinions, no doubt, are

James Whiting, Engraver and Printer to his Majesty for the Prevention of Fo
Beaufort House, Strand.

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original; but they are all deduced from research and observation, and actual experiments of ten years' study and labour, accomplished at considerable expense.

Should any suggestion in the following treatise meet the approbation of the Members of your Honourable Society, or the Public at large, I shall feel sincerely happy at having been the means by which attention has been drawn to the subject.

I beg leave to subscribe myself,
My Lords and Gentlemen,
Your's and the Public's
Devoted servant,
JOHN LINGARD.

31, Penton-place, Pentonville.
June 18, 1827.

PREFACE.

So many have been the authors who have unsuccessfully proposed to themselves the accomplishment of the object to which the present undertaking is directed, and so great has been the difficulty of the subject itself, that some persons will, probably from those very circumstances, be inclined to consider the present as only a similar attempt to effect what they may suppose an impossibility, and consequently will, without reading, reject it.

But to such persons it is apparently necessary to observe, that in all cases, and in all inventions, many unsuccessful attempts have preceded that which has at length established itself by the strongest evidences of reason and facts, and that, till the actual reception of this last, the subject has been regarded by all, or the greater part of mankind, as unattainable. These previous discouragements have not, however, been of sufficient avail to deter better informed persons from exerting their best endeavours on other principles; and it is to the interest of the world at large, that sincere and well-weighed attempts, founded on rational grounds, should be at least so far encouraged in the first instance, as to have a fair opportunity afforded for trying the merits of their pretensions to success.

What, for example, would have been the state of all the arts, if successive attempts at improvement had never been made and encouraged? or what must have been the condition of literature or science in general, if one opinion, however erroneous, was not to be questioned or examined, because it had antiquity to boast of? or another, however correct, was not to be received or admitted, because it had never occurred to the minds of authors who flourished more than two thousand years ago?

Every man of science and candour must acknowledge, that it is as great an imputation on his understanding not to admit or perceive the force of an argument, when well supported by all the rules of logic and reason, as it would be to credit and give assent to one wholly destitute of those supports. Nothing is or can be so injurious to intelligence, to the arts, and to science, as fallacious arguments, when applied in opposition to improvements; because, by such means the investigation of truth, instead of being promoted and assisted, is rendered more difficult and laborious, and the necessary patronage becomes diverted. In the instance of the Government of this country, from the multitude of applications to exhibit new inventions and improvements, they are obliged to be cautious in their patronage and support; yet, when once they see a decided ground of probability for success in any improvement laid before them, they are ready to attend to any suggestions to establish the same, and generally evince a desire to encourage investigation, and sometimes to allow of the necessary trials.

Considering the importance of preventing premature decay in Timber, which for many years has been so destructive to the shipping and buildings of this country, it is hoped that, in the present instance, when so decided a probability of its extermination is here set forth, that men of science, and those in a situation to afford the means and power of encouraging all possible chance of any improvement that may be made on so necessary a material as the present subject treats upon, they will first coolly and deliberately examine, and with the strictest scrutiny, all the facts and principles on which the tests of the present proposal rests; and if they find, as it is presumed they will, the hypothesis fully supported by sound argument, actual experiments, intelligent researches, and observations of nature, that they will then do every thing in their power to obtain the means of subjecting the plans here laid down to a fair trial, for the purpose of establishing their merits, for the advantage of the nation at large.

It must not be considered uncourteous to remind professional gentlemen, who generally superintend the application of Timber in public and other buildings in this country, that the grandeur and magnificence of ancient and foreign buildings must have been greatly supported by the durability of the Timber, seldom or never requiring repairs; consequently one stupendous edifice was erected after the other to an amazing extent, some of which are still to be seen, although many centuries have passed by. Can it be possible to suppose that premature decay, or what is called the Dry Rot, could even have been known in those days of magnificence ? The very circumstance of such a thing showing itself must have chilled every idea of erecting such buildings. If such a malady had then been known, it would have defeated the grand object in view, that of handing down to distant ages and to posterity the magnificence of the times; the consummate skill of the artist in sculpture and mathematics; the profundity of science; and the noble minds of the RULERS, whether Emperor, King, or Consul, to show the grandeur of the times in which they lived and governed. If this is any thing like the truth, is it not a sufficient stimulus to every one engaged in building to court study for improving the durability of Timber, in order to vie with those in the same line of former ages? May not then the same cause and spirit of magnificence, in erecting more noble edifices, show itself in this country, if the same security for the durability of Timber can now, as heretofore, be established? for there is no material made use of in Great Britain in which the durability is of more consequence than TIMBER, both for the use of public buildings, and for the use of shipping; yet there is no material more neglected, or which has less study applied to improve it, which is a professional oversight: and it often happens that Timber is put into a ship or building nearly half decayed, through being soaked in water, or being too much exposed to the changes of the atmosphere, from a supposition that Timber so treated does not sustain any injury, and that its durability is not much diminished, which is a lamentable error.

The purport of this treatise is to submit to the public at large a remedy for this dreadful disease in Timber called DRY ROT, as well as to submit some remarks upon the improper treatment of Timber in the process of seasoning, which remarks are deduced from experiments, prosecuted at great expense and labour by the author for the last ten years.

The reader must be prepared to find this subject treated in a very different manner to all former writers, whose opinions are mostly deduced from theory, when the opinions contained in the present treatise are digested from actual experiments, observations, and researches in nature, the results of which have led the author to lay down an hypothesis, supported by analogies strictly according with natural history, illustrated by extracts from the elements of chemistry by authors of the first celebrity, and the conclusions are all drawn from the general laws of vegetable economy; the whole tending to simplify one of the most conflicting and jarring subjects, that has always divided the opinions of ancient and modern philosophers who have written upon it, viz. the real cause of fungi and the decay in Timber called DRY ROT. In order to avoid all former errors, which have arisen by these authors taking up the subject at the conclusion instead of the beginning, the present author sets out by tracing the growth of the tree from its primitive matter, such as the acorn, slip or shoot, either of which contains the first principles and properties for the production of the tree, and by tracing all these ramifications, organized by the laws of vegetable economy, on which the synthesis or composition of Timber is formed. This is the surest way to elicit all the various modes of decomposition, and all the various forms of excrescences which are thrown out and appear on the natural decay of vegetable matter, particularly that of fungi in Timber. He has also shown the variation or constancy of temperature necessary for the growth or preservation of Timber. In the performance of this task, he has gone on, step by step, through the various digressions in composition producing decomposition, set forth in nine Sections, consisting of but a few pages each, of plain and intelligible facts; together with some ingenious and well-digested analogies, new but sound in reason, and well worth the attention and reading of the public in general; all of which are laid down sufficiently clear to enable the reader to judge of his own case, should his house or estate be effected; or, at any rate, to enable the surveyor or builder to prevent any building they may erect from being affected with what is so ignorantly termed the Dry Rot.

The author begs to observe, that if any harsh terms are made use of in this treatise respecting the want of judgment in the decay of Timber, it is not meant to reflect personally upon so honourable a body of men as surveyors and builders generally are, but forcibly to point out their want of study in this particular branch, thereby remaining ignorant of the constitution of Timber. At present, they most undoubtedly stand exonerated from all blame upon this point, no standard having as yet been established to ascertain or fix the true cause of premature decay in Timber; because as yet nothing but theory is to be read, therefore they can only follow the errors of their predecessors; and what is wrong now, has been wrong for many years. But the author truly and sincerely hopes to find this the age for liberal improvement, and that the opportunity which the surveyors and builders will now have to get information through this little treatise, will enable them finally to eradicate so dreadful an evil to the commonwealth of Great Britain, as that disease in Timber called Dry Rot must occasion; and the author hopes all scientific men will digest the arguments in support of the hypothesis by analogy, in the Eighth and Ninth Sections, upon the real cause of fungi and premature decay in Timber, before they give their opinions; and if it should be found that the author has established the desideratum, that they will not withhold the merit due to him.

It is the author's intention to follow this treatise up with a public lecture or two, to exhibit all his various experiments and matter collected in his researches and observations, which it is impossible to detail in a publication like this with any thing like justice to the importance of the collection so made, some of which are strikingly novel, and will elicit a fund of truth in natural history never yet published.

A
PHILOSOPHIC AND PRACTICAL
INQUIRY,
&c. &c.

SECTION I.

ON THE EXISTENCE AND PREVALENCE OF DECAY IN TIMBER; THE CAUSE AND EFFECT OF THE SAME, SUPPORTED BY VARIOUS EXTRACTS; ALSO, AN EXTRACT OF THE BUILDING OF THE ROYAL SOVEREIGN, AND HER FINE TIMBER, &C. &C.

FEW persons, it is presumed, can be so little acquainted with Natural History as to be ignorant, that although the progress of the growth of Timber-trees is slow and gradual, yet when once arrived at maturity, its advances to decay are often very rapid; nor is it imagined necessary to inform any one of the fact of the actual existence of that species of decay in Timber, denominated DRY ROT,* or that it exists to an astonishing degree in various buildings, and in the shipping, of this and other states of Europe, whether employed in the Royal Navy, or for commercial purposes; and that there are but few buildings which are secure from early decay in some part or other of their timbers, even although the timbers may have been well selected, and have undergone the best method of seasoning, or what is considered the best; but, I am sorry to say, bad indeed is the best method of the present day, in the treatment of Timber. And how can it be otherwise expected, when nothing but convenience and interest is studied, such as floating timber in ponds, &c., and piling thousands of loads together, to heat and ferment, creating in the first instance, the cause of that decay, which confounds the whole world to explain; and in no instance, has the true cause been suggested or thought of; but if the same practice is continued, the time will arrive, when the country will be in want of proper Timber to erect her national bulwarks.

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* Mr. T. Wade, who has written on this subject, and whose little Treatise is full of science, and by far the best on this subject, denounces the term Dry Rot a misnomer.

To counteract this prevalence to decay, in the Timbers of the Royal Navy of this country, upon an accurate computation, would be a national saving of near twenty millions every fourteen years, during a war; as every ship in the navy, by expense in repairs, during the space of fourteen years, is equal to being rebuilt, and the same may be said of ships in the merchants' service, trading to the East and West Indies, and other hot climates; and it is not uncommon to see a stupendous ship, which has cost upwards of twenty thousand pounds in building, condemned to be broken up in a few years, comparatively few, when we consider, that Timber-trees are nearly two hundred years in arriving to maturity, before they are fit for very large ships.

It is no less frequent, that when a nobleman or gentleman has been at the expense of building or purchasing a mansion for his residence, the building is very soon found to be affected with what is termed the Dry Rot, and in a short space of time the edifice is obliged to undergo a considerable repair, if not wholly pulled down, which circumstances have been more frequent of late than formerly, for we have before us very ancient buildings, whose timbers are still sound, and we have before us new buildings, whose timbers are in a state of decay.

This infers, that the constitution of Timber cannot maintain the present mode of treatment in seasoning, and in the present construction of buildings, where it is either placed in situations that must bring on premature decay, or it is put into a building in a state to produce its own destruction; either of these cases will cause what is so erroneously called the Dry Rot. Surveyors and builders have not sufficiently studied the nature of Timber, to judge correctly of the true cause of its premature decay, or how to secure its durability in a building or ship, as in the cases of the Royal Sovereign, and William, stated below.

In the case of the Royal Sovereign and Royal William, noted for their long service and sound timbers, these ships were both built by Royal order, and the timbers were selected at great labour and expense; at which time England could boast of a great stock of very fine and very large Timber, it is therefore evident, from the following extract, very large and fine Timber was selected, without spot or blemish:—

Extract of a Description of the Timbers of his Majesty's

Ship Royal Sovereign, built at Woolwich, in the year 1637:—

"To the glory of our English nation, and not to be paralleled in the whole Christian world, one thing is particularly worthy of remark at least, if not of admiration, (her timbers.) One oak-tree made four of the principal beams of this great ship."—"In the year 1684, which is forty-seven years after she was built, her planks were stript off, and the original timbers that were then remaining in her were sound, and no easy matter to drive a nail."

The use of fine large Timber, well and properly seasoned, is of great advantage, and when Timber is large enough to be laid open to the centre, which is the place in all vegetables most prone to decay, this part is laid open to season; so that when a tree is large enough to be cut through to make two or more beams, decomposition is much impeded; a beam or girder made out of one tree, may be tougher than one cut out of a large tree, but it cannot be so well seasoned. The case of the timbers of the Royal Sovereign is a positive proof, that they were both sound and strong enough to last four times as long in the service, as ships of the present day. The Royal William was in the service nearly one hundred years, which is a proof that large Timber is more durable than small, from having less acid in proportion, and by having the centre laid open.

Hill, on the Constitution of Timber, is very elaborate on this subject. He proves that all new shoots protrude from the very centre of the stem or branch; for in the very centre is a circle, consisting of rind, bark, sap, and heart, ready to protrude whenever Nature calls them forth. This circle, says Hill, is often mistaken for the pith, and when the tree arrives at maturity, it is the first part to become rotten, hence hollow trees, and the fact of beams and girders being found rotten in the centre, when all the smaller scantling are found sound. This circle contains more acid in proportion to the wood, consequently more subject to action by fermentation; the acid extracted from wood is called, in its first state, pyro lignic acid; when, after undergoing a second distillation, it takes the name of aceteous acid. The following extract is from Lavoisier's Elements of Chemistry, Section 29, Observations upon Pyro Lignic Acid and its Combinations:—

"The ancient chemists observed, that most of the woods, especially the more heavy and compact ones, gave out a peculiar acid spirit, by distillation in a naked fire; but before Mr. Goetling, who gives an account of his experiments upon this subject in Crell's Chemical Journal for 1779, no one had ever made any inquiry into its nature and properties. This acid appears to be the same, whatever be the wood it is procured from. When first distilled, it is of a brown colour, and considerably impregnated with charcoal and oil; it is purified from these by a second distillation."

It is necessary here to observe, that there can be no decay in Timber, except by the action of a putrid vegetable fermentation, by which it is evident, the component parts of Timber are destroyed by the effects of this acid. The following extract, also from Lavoisier on putrid vegetable fermentation, will illustrate it.—(Chap. XIV.)

"The phenomena of this putrefaction are caused, like those of vinous fermentation, by the operations of very complicated affinities. The constituent elements of the body submitted to this process, cease to continue in equilibrium in the threefold combination, and form themselves anew, into binary (or twofold) combinations or compounds, consisting of two elements only; but these are entirely different from the result produced from the vinous fermentation; instead of one part of the hydrogen, remaining united with part of the water and charcoal to form alcohol, as in the vinous fermentation, the whole of the hydrogen is dissipated during putrefaction, in the form of hydrogen gas, while, at the same time, the oxygen and charcoal uniting with caloric, escape in the form of carbonic acid gas, so that when the process is finished, especially if any of the materials have been mixed with a sufficient quantity of WATER, nothing remains but the earth of the vegetable, mixed with a small portion of charcoal and iron. Thus putrefaction is nothing more than a complete analysis of vegetable substances, during which, the whole of the constituent elements are disengaged in the form of gas, except the earth, which is left in a state of mould."—"Such is the result of putrefaction, when the substances committed to it contain only oxygen, hydrogen, and carbon, and a little earth."

The bearing which the above extract, on the putrefactive progress of vegetable matter, has upon the present inquiry, will illustrate and prove, that every species of decomposition or decay in Timber is a species of putridity, whether it be what is called the Dry Rot, or Common Rot, either in a house or ship;—therefore, any thing that will prevent putridity, will preserve Timber, the component parts of which consist of oxygen, hydrogen, and carbon, precisely the same elements as stated by Lavoisier in the above extract, and which component parts are in the following ratio of 100 parts:—Carbon, 52-53; oxygen, 41-78; hydrogen, 5-69. The oxygen and hydrogen being in the exact proportion of water, it may be again thus stated—carbon or charcoal, 52-53; water, 47-47, making together 100 parts; and, however dry the Timber may be, the admission of water at any time will cause a putrid fermentation to begin, and, according to the high or low state of the fermentation, the Timber will be able to resist its effects; but the moment the acid is set free, decay begins, and in some cases fungus is created. If the fermentation is weak, decay is many years in progress; on the other hand, when fermentation is strong, but few years are necessary to reduce the largest and soundest piece of Timber to little more than earth.

REMARKS.

Any discovery or invention which would in any way lessen this evil, by retarding even for a few years the decay of Timber, would so far be entitled to encouragement; but one, if it could be found, which would effectually stop it, by neutralizing the principles from which the decay of Timber must arise, cannot be too highly praised or too strongly recommended. That such a discovery is still within the reach of possibility, and even of probability, notwithstanding the failure of those who have hitherto professed to suggest a remedy, is reasonably presumed will be fully demonstrated in the course of the ensuing pages, arising out of researches and actual experiments. Every experiment that could be suggested has been tried; and although those hereafter stated in a Section at the end of the book, are only a part of those which have been made, yet to such an extent has the desire for ascertaining the fact been carried, that gentlemen of known abilities and information, chemists of the first celebrity and talent, and others, in various departments, have been, at different times, consulted on the surest methods of evidencing the positions on which it rests, and they have been approved by all; these tests are decisive, and justify the author in asserting, that the desideratum is at length established, the advantages of which must be of the highest importance to this country at large.

But if the opinions here stated in the several Sections, upon the cause and effect of premature decay, and the various causes that create decomposition in Timber, should appear new, and the opinions of others considered more consistent, as to the origin of the disease, still my remedy to effect the preservation of Timber stands the same. I can only observe, my observations from Nature, and my experiments, bear out and support my opinions; and that my rules are grounded according to Sir Isaac Newton's lesson, " by just inductions from experiments and observations, to discover the laws of Nature, and then to apply those laws to the solution of the phenomena in question."

SECTION II.

ON THE COMPARATIVE CAUSES OF ACTION IN THE COMPOSITION OF THE GROWING TREE, AND THE DECOMPOSITION OF TIMBER EXEMPLIFIED, UNDER THE LAWS OF MATTER AND MOTION, ATTRACTION AND REPULSION.

THE principal reason why former attempts have not succeeded has been, that their authors have not taken into their consideration, the matter in question in its primitive bearings, but have taken up their subject at the time they should have left off, viz., they begin just at the time when decay appears; when, from the nature of things, and the situation in which the Timber is placed, it ought to have been anticipated that a premature decay must take place; they could only see that some remedy was necessary; but they had no idea of what nature the remedy ought to have been, nor have they endeavoured to trace the original cause and source of the evil by any investigation into the laws of vegetation, the growth of the tree, or the causes of decay after it is cut down, but have confined themselves entirely to the object of stopping the progress of a disease they did not understand, by the application of some ineffectual means, which had not even the power to stop the evil for a short time; they were not aware, that the natural constitution of the Timber could not be preserved in the situation in which it was placed; they were not aware, that the absorption of water destroyed the very cohesive powers of attraction, and that the disunion of its particles and principles, by the power of repulsion, could be so effected in this situation, that their remedy was not calculated to increase the former, and proved ineffectual to prevent the latter; they were consequently defeated in their intentions.

To avoid a similar error in the present undertaking, the nature, constitution, and growth of Timber-trees, in all their various stages and progress to maturity, or to subsequent decay, have been most assiduously studied and examined, and the result of the inquiry has produced the following observations, in which the only solid basis for a remedy that can be applied with hopes of success, are here communicated, under the laws of matter and motion, taken from Sir Isaac Newton.

"The first law of matter and motion is, that all bodies have such an indifference to rest or to motion, that if once at rest, they remain so, till disturbed by some power acting upon them; but if once put in motion, they persist in it, continuing to move right forward perpetually, after the power which gave the motion is removed, as also preserving the same degree of velocity or quickness, as first communicated, not stopping or remedying their course, till interrupted, or otherwise disturbed by some new power impressed.

"The second law is, that the alteration, whether from rest to motion, or from motion to rest, or from one degree of motion to another, is always proportionate to the force impressed; a body at rest, when acted upon by any power, yields to that power, moving in the same line in which the power applied is directed, and moves with a greater or less degree of velocity, according to the degrees of power, so that twice the power shall communicate a double velocity, and that three times the power treble the velocity."

To apply the principles of the above laws to the present purpose, it is only necessary to observe, that by the power and force of fermentation, produced by the action of heat and moisture, vegetation is kept in motion, producing an increase of bulk in the tree, by a continual supply of cool matter from the roots, and the faculty of discharging by transpiration all the superfluous matter of heat and moisture; thus preventing putridity by continual motion.

When the tree is cut down, it still contains the quality of being acted upon by the action of heat and moisture, but loses the power and faculty of discharging by organic transpiration, the superfluous matter from which putridity proceeds; and the consequence is decay.

The laws of matter and motion are still further exemplified in the case of the vegetable kingdom, by the fact, that in all vegetable productions, from the tenderest flower to the lofty oak, they are propagated by portions of matter comparatively very small, such as merely a seed, slip, or cutting, which if not sown or planted, but kept in a dry place, would remain at rest; but when sown or planted, the power of fermentation will set the juice in motion, which, however weak, and in whatever line directed, will not stop, or cease to move, without some cause to impede it. Frost and the chill of winter will for a time check the action of vegetation, until the heat in summer has acquired sufficient power to set it again in motion, and from a mere acorn or shoot, as in the case of the oak, in the space of two centuries becomes a stupendous tree.

While the motion of the juices of the tree proceed in their natural direction through all its branches, and the same proportions of heat and moisture as settled by Nature, are preserved, which of course they are, so long as the tree is growing, the effect is visible in the consequent health, improvement, and increase of bulk; and also in the production of foliage peculiar to its kind and species; but if the circulation should be impeded or checked, or the quantities or proportions of the principles of heat and moisture be varied, by the intervention of some accident when growing, the consequence is seen by some deviation from the usual health and vigour of the tree, and decay in some part is sure to take place, and oftentimes fungus will appear, a certain sign of a partial decay.

Thus the laws of matter and motion are always to be exemplified by the organic changes of fluids forming solid bodies, as in the case of the growing tree, as also by the inorganic changes of solid bodies, to resume its former fluid state, as in the decomposition of the Timber. These changes are all affected in vegetation by fermentation, either organic or putrid: the organic, by water being taken up by the roots into the pores of the tree; the putrid, by the admixture of water with vegetable substances no longer growing, of which class Timber is to be considered.

The organic fermentation in the growing tree, dissipates all the superfluous aqueous matter, by transpiration through passages ordained by Nature for that purpose, and the secretions are formed into a solid body, producing Timber; but whenever any of the aqueous matter which should be carried off is impeded, no consequence in what part of the tree, decomposition immediately begins; the high winds will sometimes overstrain and rupture the vessels and pores of the tree, which causes decayed spots and blemishes, which are seen when the Timber is laid open on the saw-pit; for such is the expansive power of water, when at any temperature above forty-five degrees of Fahrenheit, that unless it can escape in the form of gas, either in the tree when growing, or the Timber when cut down, decay must ensue. Having said thus much on the laws of matter and motion, those of attraction and repulsion stand next, which exemplify the manner in which the particles of things are held together, and by what means they are disunited.

The Second Law of Attraction.—"Corpuscular attraction acts differently on different bodies, according to the degree of force in which it acts between the particles of matter: the bodies appear under different forms—

"First, it is on this account that rock salt, flint, diamonds, and various other precious stones, are extremely hard; for the corpuscular attraction unites the particles of these bodies with a great degree of force; hence, a considerable mechanical effort is necessary to disunite them.

"Second, in blocks of marble, chalk, lime, &c., the particles are held together with a force considerably less. In these bodies, it prevents all relative motion among the particles themselves; and hence, the motion of one particle is followed by the motion of the whole mass; or if that is impossible, the cohesion is destroyed altogether, and the piece breaks.

"Third, the integrant parts of wax, tallow, suet, or lard, may be made to change their situations with a less degree of force than the former. In these instances, the motion of one particle of the body is not necessarily followed by that of all the rest; neither does that motion destroy the cohesion, nor break them."

Third Law.—"Corpuscular attraction may be annihilated by every effect which tends to separate the particles of bodies; it need hardly be mentioned, that all mechanical force, such as grinding, cutting, rasping, pounding, breaking, &c., are of this nature.

"In all these cases, the force applied must be more than equal to the force of corpuscular attraction; and, as it was stated before, the corpuscular attraction acts with different degress of force between the particles of different bodies; so different degress of force are necessary to destroy that corpuscular attraction in different bodies.

"Hence, chalk is more easily reduced to powder than flint; wood is easier broken than lead; lead is easier broken than iron, &c. &c."—Accum.

The laws of attraction and repulsion apply to the present subject so far as to illustrate, that Timber, like every other body in nature, consists of particles; and that its particles are held together by corpuscular attraction and cohesive power; and as long as the power of cohesion can be maintained, Timber cannot be decomposed, or become rotten; and the rotting of Timber, under any species of decay, is nothing more than the separating of its particles; while it is well known that Timber does undergo a premature decay, and does, in many cases, very soon become rotten; which is neither more nor less than the particles of the Timber being destroyed by the power of repulsion, which is the power in opposition to the power of attraction. The power of repulsion is effected by caloric, or heat; it is no matter by what means heat is created; Timber holding moisture, and placed in a confined situation, will create heat enough to separate the particles of Timber of the largest dimensions; but it requires the heat of the blow-pipe to separate the particles of the diamond; and so on in proportion of the different degrees of force required, more or less in different bodies.

It is here made plain, that the Constitution of Timber has never been studied; therefore, whoever wishes to become a successful candidate to establish a desideratum for the preservation of Timber, and to put a stop to what is so generally called *the Dry Rot*, must give to Timber such an increase of cohesive power, as to maintain its corpuscular attraction and soundness, against any temperature or degree of caloric that can be raised within the timbers of a ship or building, by the effect of heat and moisture, let the local cause be what it may.

The power and effect of Caloric, taken from Dr. Wm. Nesbit's Chemical Dictionary, will give an increased idea of its force and action on Timber.

"Caloric appears to be an highly elastic and imponderable fluid, and is so very subtle, that neither has its gravity been ascertained, nor its existence in a simple and uncombined state been shown. It combines chemically with all bodies, in a quantity proportioned to their affinity with it. By its elastic power, or power of repulsion, it constantly tends to separate the particles of matter, in which it is opposed by the attraction of cohesion; hence, attraction predominating, the body exists in a solid form. Caloric existing in such a proportion as to weaken the attraction of cohesion to a certain degree, the body assumes a liquid form; and when the quantity of caloric is carried still higher, the body takes a gaseous form."—NESBIT.

REMARKS.

In the next four Sections will be shown the operative effects of the above laws, both as to composition and decomposition of Timber, when it will be clearly illustrated that the laws of matter and motion, and corpuscular attraction, are the laws which Nature employs in the production of the various bodies always before us, of which Timber is one; and that the same laws of matter and motion, with the aid of the power of repulsion, is the force employed by Nature for the decomposition of the same bodies. The operation of the first law will be shown, by placing before the reader the situation and temperature of the growing tree; and the latter, by exhibiting the situation and temperature in which Timber is certain of being destroyed. It will then be shown, in what temperature Timber can maintain its soundness.

SECTION III.

ON THE CONSEQUENCES AND EFFECT OF EXPOSURE, IN THE CASE OF THE GROWING TREE, AND AFTER BEING CUT DOWN AND BECOME TIMBER, TO AN EQUAL AND UNEQUAL PRESSURE OF TEMPERATURE OR ATMOSPHERE, ACTING UPON THE TREE OR TIMBER AT THE SAME INSTANT.

THE tree, whilst growing, is, at all seasons of the year, exposed to an inequality of temperature at the very same instant, for the parts above the ground are subject to one degree of atmosphere, while the roots and that below the ground are certainly placed in another. In winter, the roots are in the warmest, and the upper part in the coolest temperature; and the frost and cold, by checking in the upper part the necessary heat, put a temporary cessation to the progress of vegetation, so as to reduce it almost to rest. The utmost, therefore, that the roots can do, secured as they are from the inclemencies of the weather, is to preserve, in nearly a state of comparative inactivity, a supply of those principles of heat and moisture in the necessary proportions, which may afterwards be set in motion, when the return of summer and genial warmth shall impart to the upper part of the tree, the activity of vegetation; if it were not so, the tree must die, for want of the necessary matter to sustain it. In the summer, the situation is exactly reversed, for then the roots are in the coolest temperature, by being protected from the heat of the sun, and the upper part of the tree in the warmest, by being exposed to its rays, which tend to relax the rigidity and stiffness of the fibres of the tree, and to counteract the effects of the cold in the upper part, by opening those pores which the cold had closed, and expelling the superfluous moisture with which they had been filled: thus the proportions of moisture, which the tree had acquired in the winter, become lessened, and the heat increased, so as to restore the necessary power of action. Vegetation is then in motion, the operations of Nature are in full force, and motion is given to matter apparently at rest.

It is evident, that in this process the juices enter the roots in a cool and unfermented state, and are permitted to ascend, according to their nature and aptitude, through capillary tubes, to the top of the tree and extremities of the branches; which process must be greatly assisted by the action of the wind, making every branch a lever, and every motion of the tree causing a pressure upwards, and at the same time a great friction, producing heat, thus creating a fermentation necessary for vegetable productions, carried on under a regular and organised law, the superfluous matter being driven off by exhalation and transpiration, preserving the necessary secretions for the production of fruit, foliage, bark, sap, &c., which become a solid body, held together by the cohesive power of attraction. During this active state of vegetation, the tree is under the influence of a high and low temperature at the same instant, the roots are at about 40, and the upper part from 60 to 80 degrees of Fahrenheit; and according to the variation of the high and low degree of temperature, so in proportion is the slow and vigorous motion in vegetation created; for instance, supposing the roots to be at 40, and the upper part at 60, the growth in vegetation will not be so rapid as when the atmosphere reaches 80.

The above remarks will no doubt illustrate, that the growing tree can only continue in health and increase in bulk by these variations or inequality of temperature, the part under ground being the coolest; for if by any means the roots were to be exposed for a length of time to the heat of the sun, it would inevitably destroy the tree; the same would be the case by the severity of winter, for the tree cannot exist, if the roots and branches are exposed to the same equal temperature for a length of time, whether hot or cold.

Thus it is to be inferred, that by an inequality or variation of temperature, the tree grows, but, on the contrary, the same variation of temperature, when cut down, produces decay; and by an equality of temperature above and below the ground the tree dies, but which is the preservation of Timber when cut down.

Similar causes must always be attended with similar consequences, so long as the bodies to be acted upon continue to possess the same qualities; and it is certainly the fact that, between a tree standing and growing, and one felled and cut down, there can be no essential change or difference in the principles and elements of which they are composed; in both cases they are capable of being acted upon by heat and moisture, although it no longer retains when cut down, as in the case of the tree when standing, the power or faculty of expelling all superfluous matter. Timber, therefore, when felled, consists exactly of the same elements, and is full of the same juices, as when growing, which, although suspended in their operation in consequence of being cut down, are yet liable to be revived and called again into action, whenever any other cause than vegetation, shall be found sufficient to give rise to the same degree of fermentation which it had formerly been subject to; and this, in the case of Timber, may be effected by any local situation in which it is placed, and exposed to the absorption of water, thereby creating in itself a putrid fermentation; decomposition must ensue, as some action must take place, and as it cannot be increase, it must necessarily be decrease.

SECTION IV.

ON THE CAUSES AND SITUATIONS PRODUCING AN UNEQUAL TEMPERATURE ON THE TIMBERS OF BUILDINGS, &C. &C.; WITH A FEW REMARKS ON FUNGI, &C. &C.

The inequality of temperature produced on the timbers of houses and extensive buildings are, from various causes, some of which most assuredly may be prevented, and some most assuredly cannot. It often happens that Timber is introduced into a building saturated with water, from the places in which foreign Timbers are kept, or being exposed to a wet season. Sometimes the cause is damp or wet ground; sometimes from badly constructed roofs or gutters; in all these cases, when the building is covered in, the moisture in the timbers produces a putrid fermentation, a damp atmosphere is soon created, the timbers become heated, which produces an unequal temperature, because that of the timbers become higher than the surrounding medium. This action is very destructive, and often produces fungus, the atmosphere being too dense to absorb and carry off the effects of the putrid fermentation, the moisture is evaporated but very slowly; the consequence is, the stamina of the Timber begins to yield to the power of repulsion, and in a few years decay appears, and fungus protrudes. Then every cause but the right is suggested how this could happen, and how to prevent it in future; the decayed timbers are often replaced with the same evil attached to the new ones; and how is it to be otherwise, when we see Fir Timbers floating in the rivers and ponds at all the sea-ports in England, until they are saturated with water, the top side exposed in summer to the heat of the sun, thus producing one of the severest pressures on the particles of the Timber that can possibly be effected, lying under this destructive element for months and years, to the great injury and prejudice of the builder and his employer? I care not for what convenient purpose the Timber is so laid, but when it has lain in that situation long, its best principles are annihilated; the equilibrium and cohesive attractions of its particles are destroyed; and, after being thus treated, it is then put into a ship or building, with only half its stamina left; then can it be a matter of surprise that it so soon becomes entirely decayed?

Many eminent surveyors and builders certainly take great care to prevent bad materials being used in buildings erected under their inspection; but it has never been conjectured, that what is called Timber, such as is used for beams or girders, can be injured by lying in water, just described. I have proved that 4½ oz. of water can be driven off from a small piece of fir, weighing only 10 oz. when wet, which is nearly half. This Timber was on the sawpit, and going to be put into a building. It must also be observed, that if dry Timber is put into a building, care must be taken that good masonry must be used; for it can make but little difference whether wet is applied to Timber before or after the erection of the building. Timber cannot resist the effect of what must arise in either case, viz. heat and moisture, producing putrid fermentation; for instance, basement stories, with damp under them, dry Timber is but little better than wet; for if it is dry, it will soon be wet; decay will only be delayed so long as the timbers are absorbing sufficient moisture: therefore every situation that admits moisture is the destruction of Timber.

In very old buildings some of the timbers are often found dry and rotten, and it apparently has been so for some years; but the Timber so found must have absorbed wet at some time or other; and, according to the state of decay when found, so must have been the quantum of water absorbed by the Timber; but when discovered, all the moisture has been dissipated off, and all further decomposition has ceased immediately: therefore the decay had only reached to a certain degree, and left the Timber with sufficient strength to support the weight it had upon it. In this case the surveyor and builder pronounce the Timber to be infected with the *Dry Rot*, and think it very fortunate it was discovered so soon, to prevent its spreading its baneful effect upon the other timbers. This is an error in judgment; for if a search had been made, it might have been discovered fifty years before, and, in all probability, would have remained so for fifty years to come, if no additional moisture had got to it. I have before observed, various are the causes that will admit wet into the Timber of an old or new building; perhaps in this case the cause might have happened before either the inspecting surveyor or builder was born, and all traces of the cause might have been done away. Defects will occur, which will admit of leakage, in the best constructed roofs and gutters, and much more so in bad ones and bad water-ways; suffice it to say, whenever the timbers of a building, either old or new, are in part decayed, although dry, moisture must have been admitted at some time or other, though unobserved, and that it will not go any further without a fresh supply of wet. This point may be depended upon in all cases, and in all situations these internal defects should be prevented by good masonry.

When we come to external situations, then it is when Timber will stand in need of some assistance; in the instance of a post, the best oak in the world will not stand that situation for any great length of time; do what you will to the Timber, or place it in ever so favourable ground, it cannot maintain the unequal pressure of temperature of the ground and atmosphere; a putrid fermentation soon begins to press hard upon its particles, and disunites them. The better to illustrate this point, I shall take a triple case: —Take three pieces of the best oak that can be got; shape two of them into posts; let them be charred, painted, or any thing else you can devise to protect them; let one of them be put into dry ground, which is most unfavourable to the growing tree, and place the other in a damp situation, most favourable to the growing tree; and at a distance from each post plant an acorn or slip: the proof of my point will rest upon the growth, health, &c. of the acorns or slips, and the decomposition of the post. It will be found that the acorn or slip will not thrive so fast in that ground where the post is the longest in being decayed, but they will thrive much better in that situation in which the post is the soonest decayed; therefore that situation which causes a quick growth, also causes a quick decomposition; and, vice versa, a slow growth, a slow decomposition. This is caused by the action of fermentation being stronger in the one instance than the other, both as to vegetation and decomposition. Let the third piece of oak be put into a dry loft, or sufficiently low under water, where no action can take place, and it will endure for ages.

The timbers of ground-floors in damp situations will soon be in a state of decay, if not prepared with some antiseptic, without which all the bottom timbers will absorb moisture, and impart it to the next; and so on, to every piece of timber that is the least connected together. Sometimes fungus will convey water from one piece of timber to the other, in the most simple manner, and it is from this cause that the idea of infection has arisen.

First, No Timber can throw out fungus without the supply of water; in fact, fungus is nearly all water, in the first instance.

Secondly, It is the nature of fungus to protrude; and it will in time, if a continual supply of moisture is effected, reach from one piece of timber to the other, and when that happens, water is communicated by the fungus, which the dry timber eagerly absorbs. Therefore it is the conveying of water or moisture from one piece to the other which causes a general destruction, not by infection, which is generally conceived; for pure water, or even distilled water, will create fungus in Timber, when no one can say that any infection can be produced from pure or distilled water. But because these things have not been sufficiently explained, and because fungi are generated somehow, it appears quite sufficient to apply this paradoxical epithet, *Dry Rot*, and then to constitute it a wonderful phenomenon. The thing only wants simplifying; because, if no fungus appeared, the Timber may be destroyed, one piece after the other, by communicating moisture to each other; for Timber is a great conductor of moisture; and it is well known that water cannot be held in its natural state when the temperature of the place in which it is confined rises above the degrees of 45 Fahrenheit. The moisture will then be dissipated out of one piece of timber to the other, if they do not even touch, by the actual process of fermentation, and this is always going on, in damp situations, in close and confined places not exposed to the eye.

The last species of decomposition necessary to mention as to buildings, &c., is that created under the influence of wet and dry, in either external or internal situations; external is the slowest process, because we have, in general, more dry weather than wet; the majority of time is, therefore, in favour of non-decomposition, the atmosphere absorbing the moisture dissipated; and it is well known that wood buildings on brick and stone foundations will last for many years.

I shall put another case, by way of illustrating my point, that every species of decay, either in the tree or Timber, cannot be termed infectious:—Supposing a number of trees, to the amount of one hundred, could be selected, all of which are in a state of partial decay, although still growing; cut down fifty of them, and have them sawed into quartering, boards, &c., for the purpose of erecting a wooden building, and after being prepared and seasoned, and the decayed part cut away, apply them to the purpose above stated, upon a brick foundation, covered with slate, tiles, or thatch, in a workmanlike manner. This building will probably last for one hundred years or more, but the remaining fifty trees will, no doubt, be quite rotten and useless in less than twenty years—perhaps not one to be seen. For the moment the tree is cut down, there will be an end to any further progress of decay that was caused by some accident whilst growing, and the boards and scantling will be fit for an outbuilding, although a great part of them will not be perfectly sound, but will endure for years; and the decomposition that must ensue in consequence of being exposed to the weather will be but slow in comparison to what would have been the case had the trees been left standing; and all that can be done to prevent the wooden building from absorbing moisture will extend its durability; while to cause the trees left standing, to take up more moisture, will hasten their decay. Thus the remaining fifty trees will soon be entirely gone, when the fifty cut down will last for years in a building, for the very reason of your having cut off the evil that caused their original decay, by depriving them of water, thereby retarding that action which produces decomposition but not infection; because, if it was an infection, the decayed blotches, which cannot all be cut out, would soon spread and destroy the building, which is never the case, the only injury the effect of these blotches are subject to is, that they will absorb more water and much sooner than a sound part. But take a perfectly sound board, and continually keep wetting it, and take a board full of these unsound or decayed blotches, and keep it perfectly dry, the sound board kept wet, will be gone long before the unsound board kept dry. You may nail the unsound board to one sound, and keep them both dry, when no infection can be created from the unsound to the sound board in one hundred years.

SECTION V.

ON THE CONSEQUENCES OF THE INEQUALITY OF TEMPERATURE ON THE TIMBERS OF A SHIP, PARTICULARLY IN HOT CLIMATES; WITH REMARKS ON THE CONSTRUCTION AND WORKMANSHIP, &C.

THE premature decay of the timbers of a ship, caused by the vast inequality of temperature from heat and moisture, when situated in a hot climate, is to an alarming extent; for when a ship that has been some time in the service, with her timbers full of water, gets stationed, for instance, at Calcutta, the heat of the climate, acting upon the timbers that are above water, and, connected as they are with the timbers below the water, causes so very high a degree of fermentation to take place in them, as often to make it very dangerous for that ship to put to sea. Perhaps the variation of from 40 to 80 degrees of heat may be acting upon one piece of timber at the same time; one end may be below water at 40, and the other end above at 80; and perhaps near one hundred pieces of timber may be in this situation at the same instant. No one, perhaps, can imagine the loss of Timber that three months will cause in one ship, in the form of gas, when in this situation; although the heat may not be carried downwards to the bottom timbers, the water will be drawn up to the top timbers, which is worse; and the repetition of this severe pressure for months causes a great action, which operates as a menstruum, so as almost to dissolve the timbers; thus a great loss of Timber is caused every day, not only in the form of gas, but sometimes by the appearance of fungi. Considering this ship as almost a solid mass of Timber, and every piece so connected and bolted together, as to appear almost imperishable and impregnable to the effect of decay; yet with all this superstructure of strength, the inequality and pressure of temperature is so great, that in a few years that mass of Timber, which Nature, with all her vast economy, has been two hundred years in composing, is decomposed in less than fourteen. When all the interior parts of a ship are well examined, it will soon be seen with what a destructive element the timbers have to contend, after leaving a hot climate, all the close places producing a most violent heated atmosphere, decomposing the timbers by wholesale. And to the great danger of mariners, those parts of the timbers are the most affected which the ship depends upon for her security to hold her timbers together against every strain, viz. her joints, mortice, and tenons are sure to be affected by this overheated fermentation; and if it were not the case, that a ship, in the first instance, is built much stronger than she need be, if her timbers were not subject to premature decay, every ship in the East and West India trade would founder at sea before the expiration of six years' service; but she is so built, that no strain can affect every timber at once, therefore she is often preserved by her construction, when half her timbers are rotten at the mortice and tenons: and when a ship is examined, to prove her sea-worthy, her construction is never taken into consideration, all the examination tends, to inspect if her timbers are infected with the Dry Rot; at the same time construing the cause of the Dry Rot to be the effect of some infection, arising out of the Timber alone, and not arising out of the situation in which the timbers are placed, and being totally ignorant of the principles and constitution of Timber. All this tends to create extreme errors, and proves that not one inspection in ten is worth a straw, because the examination has no real system, nor have the inspectors any judgment to guide them. The natural tendency of Timber to decay, in the situation in which it is placed, never enters their heads; they only look for some unnatural cause, the *Dry Rot;* and if that is not to be found, they do not examine any further, but pronounce the ship sea-worthy, when perhaps half her mortices and tenons are rotten. No man can well be said to be competent to examine the timbers of a ship, unless he well understand the true cause of premature decay in Timber, and so far knows its constitution, as to be able to judge what pressure Timber can endure, when placed in the different situations of a ship, and to be able to ascertain what extent of injury her leakage has done to her timbers, which is a very material point, although not much thought of, by inspectors or builders of ships.

Their principal examination is to strip off a few planks, and bore a few pieces of timber, to look for this Dry Rot, when the parts most affected are the most difficult to get at, and, therefore, are often passed over; taking it for granted, if the middle of the timbers are sound, the ends are sound also.

Even in the workmanship of such an immense pile of wood, many of the timbers get very badly put together, when the water soon makes way amongst them, and the work of destruction begins. I have not the least doubt but a bad workman sends many a ship to the bottom, although he may have had the using of good Timber; and I have also no doubt but a good workman often saves a ship, by making good work with indifferent Timber. When we contemplate the horrors of a ship foundering at sea, with all hands on board, without a single rock to injure her, there must be something very deficient, either in workmanship or Timber—for a frame so constructed to fill with water in an instant, and go down, appears a paradox—when, no doubt, this ship was inspected before she left the port she sailed from. Therefore the present mode of inspecting seems to be a kind of hit or miss job, whether any good is done or not by the inspection; and it always will be the case, so long as such a gross error, as a supposed infection, produces the disease called Dry Rot, continues to be a generally received opinion. I hope such an opinion will soon be exploded.

Having stated thus much upon the variations and inconstancy of temperature in the three last Sections, I will, from valuable extracts, treat in the next upon the good effects of an equal and constant temperature.

SECTION VI.

SHOWING THE GOOD EFFECT OF TIMBER BEING IN A CONSTANT AND EQUAL TEMPERATURE, FROM UNQUESTIONABLE AUTHORITIES, &C.

THE inequality of temperature having been fairly stated, and the effect of such inequality having been shown and clearly proved to be the real cause of premature decay in Timber, I now proceed to give a few extracts from undoubted authorities, in proof that in a constancy and equality of temperature Timber will endure for ages.

Sir Christopher Wren, in his Letter to the Bishop of Rochester, inserted in Wadman's History of Westminster Abbey, notices " That Venice and Amsterdam, being both founded on wooden piles immersed in water, would fall, if the constancy of the situation of those piles in the same element and temperature did not prevent the Timber from rotting.

Innumerable have been the instances of piles having been drawn up sound, after being for centuries under water. It is recorded that a pile was drawn up sound from a bridge on the Danube, that parted the Austrian and Turkish dominions, which had been under water one thousand five hundred years; the piles under London Bridge are sound, after being driven seven hundred years.

It may be necessary to inform the reader, that Timber, being thus placed under water and out of the effect of the atmosphere, is equally preserved from decay as if placed in a dry situation and out of the effect of moisture; because in either case the Timber is placed in an equality of temperature or surrounding medium; or, in other words, being sufficiently low in water it is impervious to the air, and being placed dry is impervious to moisture; the desideratum is, to make Timber impervious to moisture in damp situations.

The next consideration is the known durability of Timber in buildings. First, the Alhambra Palace in Spain. The timbers of this palace are supposed to be near three thousand years old; it was brought by the Moors into Spain, and erected by them about two thousand years since; and when brought into Spain it had been before erected and taken down. The timbers are now as sound as in the first moment; and it is well authenticated, that no insect will live in the place; for if one is taken into the palace, it dies immediately: it is conjectured the timbers were impregnated with some composition. See Murphie's Arabian Antiquities of Spain, published by Cadell and Davies, Strand.

The roof of Westminster Hall is another instance of the durability of Timber, when secured by good masonry, from the effect of moisture, thereby being preserved by a constant and equal temperature. This roof is several hundred years old, and perfectly sound at this time. Numerous gentlemen, as also surveyors, &c. are no doubt in possession of similar facts in other buildings, that are some hundred years old; nor need I remind them of the numerous complaints to the contrary in modern-built mansions, &c. being often affected with premature decay in their timbers.

It is not however to be inferred, from the natural propensity of Timber to putridity and decay in modern buildings, that this evil necessarily is invincible, or that it may not be conquered and effectually subdued by a proper application of fit and adequate means; nor is it hastily to be concluded, that because all former attempts have hitherto failed, that all further attempts must in like manner be equally destitute of success; on the contrary, the possibility and practicability is hereby intended to be established, and the points already stated will most decidedly show, that nothing will be attempted which has not actual experiments to establish the fact.

SECTION VII.

ON THE SEASONING OF TIMBER, &C.

VARIOUS are the plans that have been recommended for the seasoning of Timber, most of which are certainly very bad. The general method is to expose the Timber to the effects of the atmosphere in all seasons; some persons have gone so far as to sink Timber in water, from an impression that it will get rid of the juices, which juices are supposed to be the cause of the Dry Rot; the oven and hot sand have been employed; so that many thousand loads of Timber have been destroyed in useless experiments. Sinking in water Timber that is again to come in contact with the atmosphere, will not only get rid of the juices, but the best qualities of the Timber also, which will be materially injured by the continued evaporation of so much moisture. The idea of saturating large Timber with water, for months together, because it has been the practice of some persons to soak in water boards that were to be laid down as floors, is monstrous; only conceive the difference in the facility of driving off the water from boards, and that of driving it off from large Timber, eighteen inches or two feet square. The boards, perhaps, will never more be wet; therefore, by this unnatural method, the first injury they receive, is the last: but not so with the large timbers of a ship, which must, from the situation in which they are placed, be continually absorbing fresh moisture; and if the timbers so soaked are placed in a confined situation, either in a ship or building, it will soon create a putrid fermentation. This process of soaking Timber in water is against all principle in seasoning; which should be, to throw off all the remaining aqueous matter that is left in the Timber, after the tree is cut down, in order to compress it; instead of introducing more water, thereby tending to soften, expand, and even dissolve it. Dry places, admitting the common atmosphere with judgment, are quite sufficient to season Timber. Moisture should never be permitted to enter Timber again, after the axe has laid it prostrate; if it does, and that repeatedly, an incipient Rot soon begins to act: although very slowly at first, its effects are continually increasing; and according to the quantum of moisture admitted, and of heat created, Timber may be decomposed in three or in thirty years.

It may be necessary to observe, that no actual progress in seasoning of Timber can be effected, until the moisture in the Timber becomes heated by a slow fermentation, which causes an expansion of the moisture to take place; it consequently then moves off by evaporation, which is absorbed by the atmosphere, when, after a length of time, the Timber becomes free from moisture, and it may then be said to be well seasoned; and no change has taken place either in the elements or combinations in the principles of the Timber. But if it is exposed to the uncertain state of the weather, sometimes wet, sometimes dry, and this for a considerable length of time, the action which is necessary to carry off so much wet becomes so great, that the very centre of the Timber can never get seasoned at all, while the external part to a certain extent gets rent to pieces, is in a partial state of decomposition, and its chemical principles destroyed by being so often wet and dry. The desideratum in seasoning Timber, is gradually to drive off all the original moisture left in the tree after it is cut down, but not by any means to admit more.

The same bad consequences that will attend hay that has often been wet and dry during harvest time, will apply to the seasoning of Timber; for if, after repeated wetting, the hay is at last got up dry, are not its best principles and qualities gone, and if put together wet will it not even take fire? Timber is liable to the very same effect, only not so soon, nor to so great an extent; it will not burst into flame, because the cohesive power of attraction among the particles is greater, and therefore they are not so soon set in motion in Timber as in hay; but in time, under the circumstances of being wet and dry, Timber will become oxidated. I have some specimens of decayed Timber that are so far oxidated as to have been nearly ready to burst into flame: from all this it is evident, a better method of seasoning must be adopted, before it can be made to endure, as it formerly did, for centuries.

The grand question is, can any person get properly remunerated for his labour, study, and experiments, even were he to succeed in adopting a proper mode of seasoning Timber? for, it would either take too much room or too much time to be encouraged, and in the minds of Timber-dealers, &c. the sooner it decays the better. Even gentlemen, when they are determined to build, are in such a hurry to get the building up, that no time can be allowed for seasoning the Timber; the consequence is, that in a little time a partial decay appears, and a hue and cry of the Dry Rot resounds for miles around the neighbourhood of the mansion; an action at law is commenced against the builder; surveyors are brought from all parts of the country, to examine the cause why this monster, the Dry Rot, should so soon appear; the building is laid open for the timbers to be inspected, and by the time the cause is determined, the timbers get well seasoned, in consequence of the moisture being driven off, by the opening of the building admitting sufficient atmospheric air to absorb it. The result is, the building gets under the protection of the law, as an heir-loom, with money enough besides to furnish it for the ease and retirement of the solicitor, while the builder and his employer get the *Dry Rot*, or in my own words a premature decay in their pockets or purse: and all that the surveyors can do, is to differ in their opinions, like all other scientific men; those for the plaintiff insist that it is the Dry Rot, those for the defendant insist upon the contrary; when the only true point that is elucidated by their evidence is, that not one of them knows any thing about the matter; for in reality they do not, nor is it possible that they can know, under the present received opinions of the cause of this phenomenon, termed the Dry Rot.

SECTION VIII.

A BRIEF RECAPITULATION OF SOME OF THE POINTS IN THE FORMER SECTIONS—THE CHEMICAL AFFINITY OR UNION OF THE ELEMENTS IN THEIR COMBINATIONS, OR SYNTHESIS—AND OF VEGETABLE ECONOMY IN THE PRODUCTION OF FOLIAGE, &C. &C.—THE CHEMICAL ANALYSIS, OR DECOMPOSITION OF TIMBER, AND THE ANALOGY OF FOLIAGE AND FUNGI, &C.

THE component, or elementary parts of Timber, consist (as before stated) of oxygen, hydrogen, and carbon or charcoal, in certain proportions, called a ternary or threefold combination. This union is formed under the laws of matter and motion, attraction and repulsion; and to trace its primitive action, we must begin with the acorn, which, of course, contains all the constituent elements and principles of Timber within itself; and, being placed in the ground, absorbs moisture, which forces the powers of vegetation into action. In this first stage, every particle of water, which is impregnated with earth, must undergo a change or decomposition, before any increase can be made in the progress of vegetation; in this change, the necessary elements are produced, consisting of oxygen, hydrogen, and carbon or charcoal, which forms the ternary combination, technically called the synthesis of the oak, or any other species of Timber. This conversion of a fluid matter into a solid body, exhibits changes which are the secret springs of nature;—that a tender plant, placed in the cold ground, shall be possessed of such wonderful power, as under so low a temperature as about sixty degrees of Fahrenheit, to accomplish the decomposition of so much water, when all the science of man cannot produce the same effect, unless by a degree of heat of from seven to eight hundred, or by some chemical union of a violent nature; so that the acorn or slip has only to be supplied with moisture, drawn from the earth into the roots, to produce all the elements and principles necessary for the growth of vegetation, and is verified in due course of time by the appearance of foliage, &c. Thus this grand work of nature passes on, without the least concern on our part, so that we can only get enough to supply our wants; the supply of which appears so very regular and simple in its nature, that the clown well understands it. Now the analysis, which in its nature is as simple; yet all the science of the world appears not to comprehend it in the least, because of the appearance in some instances of fungus, the production of which is as natural to Timber when cut down, as that of foliage is to the tree when standing; for, by analogy, the effect of these productions is from the same cause. The appearance of foliage must be considered an organic production, and that of fungi an inorganic action; the former is a proof of increase, the latter a proof of decrease, which is certainly a great difference; but such are the laws of matter and motion in the production of vegetation, that composition or decomposition are a *sine qua non* with nature; if increase is checked, decrease must follow, even in the growing tree; therefore it is plain, foliage, &c. in the tree, is analogous to fungus in the Timber. For it is proved beyond a doubt, that if by any accident a rupture takes place in any part of the branches of the tree, instead of foliage, shoots, &c. we see fungus; for, from the moment the organic action is lost, putridity commences in the growing tree, and continues so long as moisture is conveyed to the ruptured part: when moisture is no longer conveyed, dead wood is the consequence; but when the tree is cut down, the organic action is certainly lost, so that upon the admission of moisture into the Timber, putrid fermentation takes place, and fungus often appears.

This point will be still farther illustrated, in the spring of the year, when all the increase in vegetation takes place, and when the secretions are first formed into something like a solid matter: if we could examine it, we should find it little more than a state of fungus or spongy matter, which in the course of time becomes concrete and hard, forming wood; therefore, there is nothing unnatural in the suggestion, that a fungus or spungy matter may not only be the last state, but also the first state of wood; or, in other words, what may be its primitive state and texture, may be its final state and appearance; which reduces the point in question to be the natural composition and decomposition of wood, or that the synthesis and analysis of vegetation will show a fungus appearance. In the first instance, all the elements are economized; in the latter they are all set free.

The following truth will furnish another proof that the ramifications of foliage and fungus are, by analogy, the same matter producing a different effect. If you train against the wall the fungus protruding from a piece of oak, it will form the portrait of the oak-tree; a piece of deal will show the portrait of the fir-tree; and so on, with every species of Timber: but when fungus is protruded in the open atmosphere, the pressure on so soft a matter forms the cap-like shape we see in general. Fungus has often been found trained against a wall, and has been admired for the beauty of its figure; had the ramifications been examined, and the species of wood from which it had sprung been traced, it would have been proved as above stated; so that nothing can afford a greater proof that the production of foliage and fungi are the organic and inorganic ramifications of Timber.

There can be no doubt but the hardest wood known can be reduced to the same soft state as at first secreted in the growing tree, and yet maintain all its powers, to extend its ramifications in the form of fungus; this can always be done, and is going on every minute of the day, by fermentation, which process is only a common decomposition, and not the consequence of a contagious or infectious disease, as is generally supposed. If all former writers had given themselves less trouble in reading other works, or writing their own upon theory only, and had exerted themselves on natural researches and experiments, to prove the point, they no doubt would have been able to come to some conclusion nearer the truth, than what they have written on this subject; they would have been able to simplify the question instead of perplexing it more and more.

Though great anxiety seems to have been felt by writers in all ages, to understand the origin or cause of that decomposition, which has so long been called the Dry Rot, yet no one seems to have taken any trouble to study the subject properly; perhaps no one thought it worth his time, so long as plenty of Timber was to be had, or that the growth exceeded the loss: but the case is far different now; the loss exceeds the growth, to an alarming degree, and the alarm would be much strengthened, if the whole British navy were drawn up in a line, so as to give some idea of the immense quantity of Timber that is wanted at least every fourteen years, and we were then informed that it requires the time of from one hundred and fifty to two hundred years' growth to replace the same quantity, thus showing, that we destroy it eight times faster than the vegetable kingdom can supply us. I should think in about another century this great waste of Timber will be severely felt, and ship Timber become scarce; therefore every well-wisher to his country will begin to see, that some steps should be taken to endeavour by some means to put a stop to this profligate loss of Timber, by premature decay.

SECTION IX.

ON FUNGI AND ITS ANALOGY TO FUSION IN METALS, AS A PROOF OF ITS BEING THE SECOND STATE OF EXISTENCE IN TIMBER OR VEGETATION IN GENERAL.

To simplify the origin or cause of fungi (the harbinger of vegetable destruction and confounder of manual science) to the satisfaction of all parties, will be a task indeed; for my own part I am perfectly satisfied as to the cause of this phenomenon, and my opinions are founded upon actual researches and observations from nature, and practical experiments, the result of which I shall freely state, without fear of contradiction on the truth of my assertions, and without personally contradicting the opinions of others on the same subject. The first thing to inquire into is, what changes and how many states of existence all bodies in nature are subject to, and susceptible of, by the alternate absorption and dissipation of heat or caloric, and by what laws these changes are governed.

EXTRACT.

" Almost all bodies in nature are susceptible of three several states of existence, viz. solid, liquid or fusion, and aëriform, and that these states of existence depend upon the quantity of caloric held in them, it is easy with a certain apparatus, with divers experiments, to determine the quantity of caloric required for converting solid substances into liquids or fusion, and liquid into elastic or aëriform fluids; and vice versa, what quantity of caloric escapes from elastic vapours in changing to liquid, and what quantity escapes from liquids during their conversion into solids."—LAVOISIER.

Again—" If the effect of heat, under certain circumstances, be carried still further than is necessary to render solid bodies fluid, vaporisation begins. Vaporisation does not always require a previous fusion; some bodies are capable of being converted into a vaporous state, without previously becoming fluid, and others cannot be volatilized at any temperature yet known."—ACCUM.

The term fusion is generally applied to metals, which is the second or middle state of existence, and I think all the rules of analogy will support the hypothesis, that fungus is the fusion or second state of existence in Timber and vegetation in general; that is, fungus is Timber in an elastic and soft state, in consequence of being heated by fermentation. This analogy is borne out by the circumstances, that metals require a greater degree of heat to throw them from a solid state to a state of vapour or gas, than to a state of fusion; so it is with Timber, it will take a much greater degree of heat to cause the entire decomposition of Timber by vapour or gas, than it does to throw out fungi; because fungus is always generated in a cool atmosphere, which reduces the internal heat caused by fermentation in the Timber. Metal in a state of fusion is visible, so is fungus; metal in a gaseous state is lost, so is Timber, and to a great extent. Metals are seldom or never thrown into a gaseous state because of the total loss, and the difficulty of preserving the temperature so high; but in vegetation it is more difficult to preserve the temperature necessary to produce fungus, than to throw it off in the gaseous state; because all vegetables are more volatile in their principles than metals, holding so much water; but the difference of these points will not affect the validity of my hypothesis, because the same laws govern both cases as to metals and Timber. The natural state of the atmosphere preserves the metal and Timber in a solid form, while a certain degree of internal heat or caloric changes the solid state of both to a state of softness or fusion, and a much higher degree of heat will produce a change of both into a gaseous state; therefore it is clear, that these different states of existence in vegetation can only be effected by the same laws that work the change of the different states of existence in metals, because no other law can effect a change in either of them; then if it is an axiom in one case, why (as Sir Isaac Newton said) is it not to be an axiom in the other? In fact it must be so, because if Timber becomes heated by internal fermentation, its particles are disturbed, and its solid state is reduced either to fungus, or is lost in gas or vapour. It is just the same with metals in the furnace, the heat created by the blast, and the heat created by fermentation, act precisely with the same effect on the particles of each body, only the particles of Timber require a less degree of heat than metals, but the state of their existence are both changed by an adequate degree of heat necessary to overcome the power of attraction in each. Metals in this second state of existence, are rather improved than otherwise, which is not the case with Timber; but in the next state of existence, viz. gaseous, they are both destroyed, and nearly the same elements are set free by the analysis; for all bodies are formed out of four elements, viz. oxygen, hydrogen, nitrogen, and carbon, and the combination of these elements are susceptible of the three several states of existence, as noticed above; each body varying in its proportions and principles. In some cases, the body consists of the four elements, in some of three elements, and some only of two; but when any of these bodies are decomposed, the elements resume their original simple state. Metals in a state of fusion, are not much altered in their elements and properties, the change is only by an excess of heat or caloric. Timber in a state of fungus or fusion is changed by an excess of heat and moisture, and the proportions of the elements are altered, therefore it cannot, as in the case of metals, return to its original solid state again, because the corpuscular attraction is destroyed in Timber; but not so in metals. The diamond has three states of existence; but when once we change the solid state of a diamond, it is immediately lost in vapour or gas, and never can resume its solid form again. No more will Timber. This point will support my hypothesis, that, by analogy, fungus is a middle state; but, like the diamond, the particles cannot be reunited again into its original solid state, like unto metals. Thus I think it is clearly proved, that the *cause* of fungi is a more proper term than the *origin* of fungi. What would be said if a person were to ask the origin of solid metal, and then ask for the origin of metals in fusion? He might ask for the cause of fused metals; he would be answered, that the particles of the fused metal were driven to a greater distance from each other by heat, than the particles of the solid metal. Therefore I think the *origin* of fungi must sink into the term *cause* of fungi, which cause is produced by the same effect that produces the change between solid metal and metal in fusion, vi z the expansion of its particles by heat or caloric; therefore we should write in future the origin of vegetation and the cause of fungi, or the origin of Timber and the cause of fungus; and the origin of grass, hay, and straw, and the cause of the mushroom. I therefore sincerely believe that fungus is only a middle state of existence and not the production of a new species of vegetation from seed, as is generally supposed to be, but which may more properly be called an excrescence forced out by excess of fermentation, still maintaining most of the properties inherent in that species of vegetation from which it proceeds. That this hypothesis should have remained so long in chaos is to me wonderful, and that these analogies on fungi here set forth should have never before been broached is also a matter of surprise. I can only account for this apathy in science, from the circumstance that the abundant supply of Timber with which Nature had in a perfect state covered the earth, did not render any attention necessary; but in the case of metals it is not produced in a perfect state, therefore man was obliged to make use of his knowledge, and become a chemist. The value and use of metals gave a stimulus to science, when, after various researches and experiments, the furnace was erected to purify that which

Nature produced impure; the art and science of man was, in consequence, put to the test to make the rough ore useful. I need not tell the reader to what an extent he has succeeded on the properties of metal; but I have to tell the world, that with respect to Timber, Nature has done every thing, the science of man, nothing; because the immense quantity of Timber with which Nature had covered the earth made it necessary actually to clear it away, therefore man became profligate in its use, and negligent in its preservation; and the only advance which has as yet been made to counteract the immense loss of Timber, by premature decay, is conflicting theory, and that consists of the most unnatural, loose, and monstrous suggestions; the subject remains still hidden in darkness, and nothing but conjectures put forth one century after the other.

With respect to the mushroom in the fields, commonly used for culinary purposes, and which in general shoots up from decayed and parched roots of grass after a long drought, followed by a copious supply of rain, which these decayed roots eagerly absorb, a violent fermentation soon begins, a rapid expansion takes place, the rain cools the air and produces heat in the ground, and in a very little time thousands of the fungi tribe shoot up before morning, particularly in those pastures where the roots of the grass have been the most injured and burnt up; but if the atmosphere of the night should be dry and heated, so as to absorb the moisture dissipated by the fermentation of the earth, which it sometimes will, in that case we see but few mushrooms. The darkness of the night has nothing to do with encouraging the growth; it is the coolness of the night air, and the heat of the ground in a state of fermentation, that forces the growth of the mushroom; but if the atmosphere should be heated, it will absorb all the moisture that is necessary to expand the fungus; the roots of grass, &c. become entirely decomposed, no cuticle can be formed to hold the heated matter necessary to produce the mushroom, and all goes off in the form of gas. In this case, although the night is as dark as pitch, and as secret as the grave, you will have little or no mushroom; all matter will be dissipated.

The field mushroom is often generated from horse dung and hay and straw scattered about the ground; and what the gardeners call spawn, is nothing but very small particles of hay and straw, and the half-concocted dung of horses in mill tracks and elsewhere, collected together and mixed with a proper compost; the temperature of which compost must be brought up above the surrounding medium; he will then get some crop: but if the surrounding medium is above the compost or mushroom bed, at the time when this spawn, as they call it, is just ready to spring up, he will in that case lose most of his crop, upon the principles just stated.

Mr. Brandt notices, in his Manual of Chemistry, second edition, vol. iii. page 8, article 1525, that "The heat of plants is in many instances above that of the surrounding medium, and there are cases on record in which very remarked elevation of temperature has been observed in them; but upon this subject we as yet have no accurate researches."

As far as my researches and observations have carried me, the heat of plants above the surrounding medium appears indispensably necessary; and that it is one of the secret springs of Nature, that when any matter is ready to protrude, the temperature of the surrounding medium should be below the temperature of the plant or tree. This variation of temperature is necessary to assist or cause the cuticle to form, to prevent the fructuating principles from dissipating, which would otherwise be the case, if the surrounding medium were to be much above that of the plant; and no doubt in all instances of protrusion, whether of foliage, fruit, branches, fungi, &c. at the time of its bursting forth, the heat of the plant must be above that of the surrounding medium, to produce not only healthy and perfect increase in vegetation, but also to allow of any parasite or unnatural soft excrescence to form, let it be what it may. If it were not so, how could the three different states of existence be accomplished, either by Nature or science. According to that state of existence, to which the change is intended, the variation of temperature must either be above or below the plant or body; but if no change is intended, the temperature of the body and the surrounding medium must be equal: for instance, in metals, if the temperature of the solid body remains at the same point as the temperature of the atmosphere or surrounding medium, its particles consequently have no motion, and the metal exists in its solid state; the temperature of the metal being elevated to a certain degree above the surrounding medium, it is held in a state of fusion. But if the temperature of the surrounding medium were to be above the temperature of the metal at melting heat, what would become of it? would it not be volatilized and be lost in gas, the same as if the temperature of the furnace were to be carried to a sufficient height to produce the vaporous state of existence? The effects of these laws in the variation of temperature in metals are only to be applied to effect the same purposes in vegetation; and prove that a cool atmosphere is necessary to prevent too much dissipation of the matter in motion, which must be fluid when the plant is in a state of fermentation, and ready to send forth its fructuating principles, that the cuticle or protruding covering may form, more particularly in the case of fungi, otherwise the whole plant or body would be dissipated in the form of gas. The surrounding medium, to produce fungus, must be below the Timber, plant, or compost; in fact, the elevation of the plant above the surrounding medium, is identically the principle which constitutes the atmosphere of spring, the cause and effect of expansion and increase in vegetation generally; but when the elevation of the surrounding medium, which is the case after the heat of summer, is above the plant, it constitutes the atmosphere of autumn; the effect of which is to collapse, shut up, and destroy all appearances of the exterior beauties of foliage, &c. in vegetation. These variations of temperature are the effects of the laws of Nature in the regulation of vegetable economy; they must exist, or the whole system of still life and animated Nature, and the globe itself, must stand still and be no more. I shall once more illustrate my hypothesis, by touching upon the three states of existence in bodies. Equal temperature of the solid body and the surrounding medium fixes that state of existence which allows of no action in the particles of the body, and it remains in a solid state; but when the temperature of the body is above that of the surrounding medium, supposing the surrounding medium not to be above sixty degrees, expansion takes place, and the solid body is changed by the motion of its particles into another state of existence, in metals termed fusion, in vegetation increase by expansion of its ramifications, either perfect or imperfect, that is, either foliage or fungus. But if the surrounding medium were to be elevated to double or treble the internal heat of the plant, &c. then vegetation makes but little progress, or is entirely destroyed in the form of gas, and no fungus can be formed; hence we see in hot climates little or no foliage or branches, and in cooler climates an excess of foliage and top wood. Therefore it appears that all protrusions must be put forth in a cool atmosphere; if the day is too hot, night is the only time, particularly in warm climates, when the heat of the atmosphere is abated, and the heat of the plant increased, which is proved to demonstration in the fungi tribe, particularly in the spontaneous growth of the mushroom in the night. This brings the point to agree with Mr. Brandt's extract in his Manual of Chemistry, on this subject, that the heat of plants is in many instances above that of the surrounding medium, which has been proved by the observation and researches made by the author of this treatise during the last ten years.

I shall now conclude the subject matter of this treatise by recapitulating the following observations:—

First, That all fungi are the middle state of existence in vegetable economy, in consequence of putrid fermentation created by heat and moisture in the solid body of the plant, from the blade of grass to the sturdy oak, which is in direct analogy to the middle state or fusion of metals, by the act of separation of the particles, in both cases, by the power of repulsion predominating over the power of attraction. Thus Timber, as well as metals, becomes soft, and is thrown into another state of existence by the intervention of a certain portion of caloric or heat amongst the particles, and the solid state of existence is lost. With a greater degree of heat both the metal and the Timber will be converted into the gaseous or vaporous state, and nothing but the earthy matter left in each, which cannot be decomposed.

Secondly, That fungus in Timber is, by analogy, from the same cause and effect as foliage, &c. in the growing tree; in both instances showing the natural ramifications inherent in the body, whether standing or felled; foliage, &c. being an organic protrusion, and fungus being an inorganic excrescence, in no way propagated by any new matter or substance applied, such as seed. The principles of vegetation in general, and more particularly Timber, have in themselves sufficient matter to throw out fungus, as the tree has capability to throw out foliage, &c. There is no point in natural history to warrant such an hypothesis, nor any deficiency in vegetable economy as to require the assistance of seed to produce fungi.

SECTION X.

ON THE NATURE OF THE PROPOSED REMEDY, AND THE SEVERAL OBJECTS TO WHICH IT IS APPLICABLE.

THE general object of the remedy to be proposed or suggested consists in the application of a liquid composition, for the very important and weighty purpose of rendering Timber impervious to moisture in all situations in which it can be placed, in a building or ship, which composition can never be dislodged, but presents an invincible opposition to fermentation.

The power and effect of this composition is such, that it cannot be evaporated or extracted by any exposition to the sun, or by any confined or damp situation; nor will the wood work be subject to contract or expand, which is very much the case with doors, shutters, and window frames, made of soft and porous wood, such as deal, &c.; but, if prepared with this composition, doors and window frames, &c. made from the softest deal, will always remain as at first fixed, neither swelling nor shrinking, becoming equal to mahogany, &c.; thus giving compactness,* strength, and durability to the most useful and cheapest article in the building department; being undoubtedly a very general and material quality in the object of economy, which renders it almost superfluous to say that it must be of the greatest possible utility to the nation at large. The increase of strength will allow of a reduction of scantling in almost all cases in which Timber is used; which would in itself be an immense saving.* A ship might be constructed many tons lighter with equal strength, and the cargo be more securely protected from damp and mildew. The dimensions of masts and spars might be much reduced also; boats and barges would be rendered more secure from leakage, and better protected against being staved. It is also an invaluable discovery for all the wooden erections and materials used in brew-houses, when the destructive effects of steam will be neutralized.

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* It will be seen by the result of the experiment No. 19, that even the sap of oak is made equal to the heart by the compressive and antiseptic qualities of the composition.

This composition acts most powerfully as an antiseptic in the oxidation or common rust of iron.†

The advantage of this composition will also be very conspicuous in the ordnance department; all the war materials, fortifications, &c. made of wood and iron will be protected by resisting the effect of heat and moisture in all destructive climates.

Even animal matter has been preserved for ten years, being perfectly sweet to this day. A slice of beef was prepared with this composition in August, 1818; the lean part is rather hard, but the fat part is now as soft and as sweet as it was at the first moment. Any gentleman may see it.

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* See experiment No. 10, on some rotten oak branches.

† See experiment No. 8.

SECTION XI.

PARTICULARS OF EXPERIMENTS, ACTUALLY MADE, FOR THE PURPOSE OF ASCERTAINING THE EFFECTS OF THE REMEDY PROPOSED.

SUCH are the effects to be produced from the use of this composition on Timber and iron; and in order to evince that these expectations are not destitute of the necessary solid foundations in facts, a sufficient number of the various experiments made on this occasion, although they bear but a very small proportion to the aggregate, are here minutely stated.

1. Two sections of white deal, each weighing one pound thirteen ounces avoirdupois weight, were immersed for six days each, the one in water, the other in composition; at the end of which time they were each taken out, and again weighed: that which had been in the water had absorbed nine ounces; and that in the composition two ounces and a half.

2. Two similar pieces of yellow deal, weighing each two pounds eleven ounces, were in like manner immersed for six days each, the one in water, the other in composition; after which time they were taken out and weighed: that which had been in the water had absorbed six ounces; that in the composition, four ounces. The water in the white and yellow deal was all evaporated on the second day after the sections were taken out; but the composition in the other two sections remains, viz. from the month

of June, 1817, to the present time, 1827, without any loss or diminution, dry and hard.

From this it appears, that white deal absorbs more water and less composition, in proportion, to yellow; and the quantity of water absorbed by the white, accounts for its more rapid decay in external situations: as the greater the quantity of water absorbed, the quicker is the Timber destroyed. For instance, a piece of seasoned oak in the same time, six days, would only absorb half an ounce; so that, in a damp situation, the white and yellow deal would be rotten in a few years, whereas the oak would last for a considerable number of years longer.

3. The two pieces of white and yellow deal, which had been immersed in the water, were again placed in water for another similar period of six days, and at the end of that time weighed: they were found saturated, but had absorbed about half an ounce of water more than before, which is a proof of a decomposition in a small degree, for there must have been a loss of wood to have made room for more water. Timber may in time be completely dissolved by being repeatedly saturated with water, and as often dessicated: this proves that improper seasoning will cause decay. They were then immediately immersed full of water in the composition, for another similar period of six days, and being at the end of that time taken out and weighed, were found to be nearly of the same weight as when they were put in. Being full of water, of course nothing more could enter; the composition only made an external casing.

4. They were next exposed to the atmosphere, in the

month of July, for six days, when no diminution in weight was produced; the composition preventing evaporation, the water could not escape.

5. After this, they were both cleft asunder, and the whole of the water evaporated, and was set free in about thirty-six hours.

This demonstrated that the composition was in itself impervious to the effect of heat, and that it had disunited the action of heat and moisture, although the composition itself was not dry: for it is to be understood and observed, that the composition is a saturating solution, and not a coating like paint. It is well known that wet wood cannot be painted, therefore paint could not have done the same thing.

6. A piece of white deal plank, about twenty-one inches long, nine broad, and three thick, weighing about nine pounds, was prepared with the composition, lightly, and placed to dry for about twenty-one days in the autumn of 1817: it was then laid in a very heavy rain the whole day, set up on one end in a gutter, the upper end receiving all the water, which ran off from the roof: after continuing fourteen hours in this situation, it was weighed, and found to have absorbed one ounce of water;* if the end of the plank had been planed, instead of being a rough saw-cut, it would not have absorbed a drachm; when a similar piece, which had been in like manner exposed in

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* This piece of plank was in use for the servant to stand upon under the sink to do her work, and various other purposes of wet and dry, for seven years, and was then equal in quality to the first day; half of it is now cut up and put under a kitchen floor.

the rain, but without any preparation from the composition, had imbibed not less than eight ounces.

7. Two pieces of deal board, about nine inches square, weighing one pound two ounces each, were laid on the grass, in a very heavy rain, for fourteen hours, in the country: one piece had been prepared with the composition, the other had not; that prepared, when weighed after this exposure, was precisely of the same weight as when it was laid down; the unprepared piece had acquired, by absorption, two ounces and a half of water.

This evidently proves, that water is not admissible into wood so prepared, though from wood unprepared it cannot be excluded.

8. A clump of oak, about twenty-one pounds in weight, with two bolt-holes in it, was laid in the composition for a few days; at the end of that time, two iron bolts were driven into the holes, and the ends were secured by pieces of lead. This piece of oak, so treated, has been put in damp situations, and even in water for several weeks, an was then deposited in a confined and damp vault for thirteen weeks, when at the end of that period it was taken out and exposed to different atmospheres or temperatures for eighteen months; the bolts were then driven out, when they were found uncorroded by rust, and as fresh as if they had just come from the smith's forge; the composition had prevented all action, so that no fermentation could take place. The bolts are now to be seen without rust.

The next class of experiments was directed to the ascertainment of the effect of the composition on decayed wood, in the several stages of its progress towards destruction, and the following observations are the result.

9. A piece of dog-wood, taken from a close hurdle, so very rotten in itself as hardly to bear the touch, was broken in half: one half was laid in the composition, and the other half remained exactly in the state in which it had been broken off: that laid in the composition became, in twelve months time, so changed from what it had been, that had not the circumstance of the exact correspondence of its irregularities with those of the piece from which it had been broken, plainly shown it to have been the same identical piece or section, it might reasonably have been conjectured that another had been substituted instead of the former; for the internal and external distension of the parts became wholly reduced; and, by the consequent shrinking of the parts into their natural and original size, the edge was rendered as sharp as when it was first cleft by the hurdle-maker.

10. A piece of rotten oak branch, about twelve inches long, and one inch thick, which had been blown down by the wind in the month of February, 1818;* the whole branch was covered with moss, and so extremely tender as to snap with its own weight. This piece of twelve inches long was broken into two sections; one of them was prepared with the composition at that time, the other remained in its rotten state. On exhibiting these experiments in the month of February, 1819, before two scientific gentlemen particularly conversant in chemistry, it was proposed to break the above-mentioned two sections of oak, in order to show, that the composition had, besides an antiseptic, or antiputrescent quality, the power of communicating also a

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* At Yatley, near the Military College.

considerable degree of additional strength. The section not prepared broke by the hands with ease; and it was expected, that although the other section would probably require more force and exertion, yet it would in like manner be broken. But this was not the case; for the power of the composition had so far exceeded the degree of strength attributed to it, that after several attempts it was found impossible to break the piece which had been prepared, by manual strength.

Another piece of the same rotten branch was broken off from the same length, and the experiment of breaking by weight was then tried. Thirty-four pounds broke the unprepared piece, when two hundred pounds did not break the piece prepared.

It is not intended to rest on the utility of applying this composition to wood, where destruction has already gone too far, as it is to show the possibility to prevent it from ever beginning—an object of infinitely greater importance. But these experiments unquestionably tend to justify a very rational conclusion, that if, as above stated, the composition has been sufficiently powerful to arrest destruction in its progress, it cannot be less efficacious in preventing decay from ever occurring—a matter of certainly less comparative difficulty.

The success of the above trials in the case of decayed wood, naturally led to another class of experiments, of a similar kind, on those sorts which were in their own nature and constitution soft and porous, in order to decide, whether even they might not be rendered firm and solid, and equally capable of effectually resisting the attacks and efforts of early decomposition and decay.

11. Accordingly, two pieces of a tender larch scaffold pole were chosen for this purpose; one piece was saturated with the composition, the other left in its tender, light, and natural state. That prepared became dense and hard, more resembling box or yew than larch, or the piece from which it had been taken.

Several similar experiments have also been tried upon fir, the specimens of which can easily be produced; and some of these have been done not less than ten years, and the pieces are now so compressed and hard, that they resemble oak in firmness.

The next succession of experiments was intended for the purpose of ascertaining, whether the composition could, in any way, or to any extent, be extracted or expelled, or forced out by any high degree of temperature, or by alternate variation from high to low, or from low to high.

12. To decide whether the composition could be disturbed or set free by heat, some pieces of all sorts of wood were dessicated, or well seasoned, and then saturated fully with the composition: after the composition became somewhat concrete, they were for three days placed in an oven, heated to not less than eighty degrees, but it had no effect; for no loss of weight was sustained, or next to none, that being fixed air, for it amounted to no more than a drachm in a pound, which does not exceed a one-hundred-and-twenty-eighth part; nor was there any appearance of external motion, which proves the composition immoveable by confined heat.

13. They were then placed in water for several days, and again deposited wet in the oven, heated as before; but

still there was no effect to disturb the composition, although the pieces had sustained alternate heat and moisture, and afterwards been again subjected to heat.

14. A piece of larch, weighing six ounces, having three ounces of composition in it, which is a very great portion, and must have been moved, if it was moveable, was boiled for two hours in water; but still there was no effect, either to dissolve the composition, or admit any fresh quantity of water: if it had been possible to dislodge or extract any of this composition, surely this experiment would have done it.

15. A piece of oak, of about two inches square, having in it full half an ounce of composition, was also boiled in water for six hours; but there was still no effect towards disturbing or setting free the composition; and it was considered, on this occasion, that the smaller the cuttings or sections, the more severe the trial.

16. Sections of deal boards, prepared with the composition, and others not prepared, have been laid in the ground in a wet ditch for several weeks together: in this case, the sections prepared have become somewhat heavier, but when placed in the oven, they returned to their former weight as before put into the ditch, but not less. The increase in the weight would, however, never have occurred, had the wood been completely saturated, which it was not.

The case was evidently different with the sections not prepared with the composition, for those pieces were double their original weight when taken out of the ditch, and much reduced in their original weight after dessication in the oven: these circumstances evince, that there was in the latter case some degree of decomposition, but none in the sections which had been prepared, as they could not be reduced below their original weight before put in the ditch.

So important are the points decided by the foregoing experiments, that it is imagined few other tests can be suggested; and at present only the following question has occurred to the mind of the author of this treatise, as necessary to be solved,—whether the composition has or not, the power and ability to prevent the formation of fungi in decomposed wood? For the ascertainment of this several experiments were tried: no one failed; and the result of the whole resolves itself into the following conclusions.

17. A section of decomposed light elm slab, about twelve inches square, all sap, but apparently dry, unprepared with the composition, was placed in a cupboard, and produced, at the end of ten weeks, an appearance of fungi, covering about two inches in length, and one in breadth.

18. Two similar sections from the same slab, prepared with the composition, but deposited in a damp vault, at the end of the same period of ten weeks, when no fungus appeared.

The unprepared section above-mentioned (17), which had lain for ten weeks in the cupboard, and on which a fungus had already appeared, was cut in half: one of these half sections was placed in the vault, and in four days the fungus had considerably increased. At the end of ten days, the whole piece was completely covered with a milk-white fungus. This section was several times disturbed for the purpose of exhibiting, which broke off the fungus; but upon being replaced in the vault, it always again recovered its growth: one of the sections (18) which had been prepared, and which had lain in the vault for ten weeks, without any appearance of fungus, was brought up and placed in the same cupboard for twenty weeks, with intention to ascertain whether the change might encourage the production of fungi; but at the end of that time it exhibited no appearance of fungus whatever.

The other section (18) of the prepared slab had now lain in the vault thirty weeks: at the end of that period no one symptom of fungus was produced; a sufficient proof, as it is contended, of the impossibility that fungi should generate on wood so prepared, even although it should have been decomposed.

19. In order that no question might remain behind unsolved, it was, in consequence of the effect which the composition was found to have had on the porous or soft woods, determined to try also what would be its effect on the sap or alburnum of oak. The composition was applied to some sappy loppings of oak, and it succeeded beyond the most sanguine expectations which could be formed. The specimen on which this experiment was made is to be seen, as well as all the others here mentioned; and without exaggeration, although no description can do justice to the effect, suffice it to say, that the sap or alburnum is harder

and closer than the heart, and is equal to any purposes that the heart can be applied.

20, and last experiment, was to prove, that oak or fir, that would not rend straight before prepared, is found to rend in great perfection after prepared, which is another proof of its compressive powers.

THE END.

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